

Set 6.0: Physical Changes

Skill 6.01: Describe the three most common states of matter

Skill 6.02: Identify the physical transformations that exist between three most common states of matter

Skill 6.03: Describe the energy changes that accompany physical transformations

Skill 6.04: Define endothermic and exothermic

Skill 6.05: Use energy diagrams to represent physical transformations

Skill 6.01: Describe the three most common states of matter

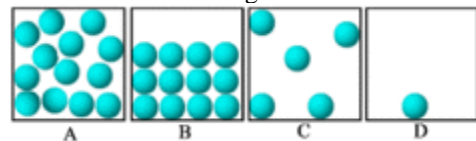
Skill 6.01 Concepts

You are already familiar with the three most common states of matter: solid, liquid, and gas (vapor). Some properties of each are summarized below:

| | |
|--------|--|
| Solid | Definite shape, definite volume, the molecules vibrate in fixed positions |
| Liquid | Definite volume, no definite shape, the molecules can slide past one another |
| Gas | No definite volume, no definite shape, the molecules are very far apart |

Skill 6.01 Example 1

Which of the following would be best classified as a solid? A liquid? A gas?



Skill 6.02: Identify the physical transformations that exist between three most common states of matter

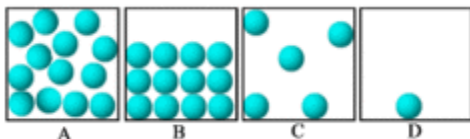
Skill 6.02 Concepts

A physical transformation of a pure substance is one that leaves it as the same substance but in a different state. The most common physical transformations are described below:

| | |
|--------------|---|
| Vaporization | Process of going from a liquid to gas |
| Condensation | Process of going from a gas to liquid |
| Freezing | Process of going from a liquid to solid |
| Melting | Process of going from a solid to liquid |
| Sublimation | Process of going from a solid to gas |
| Deposition | Process of going from a gas to solid |

Skill 6.02 Example 1

Each box shown contains a single atom or a sample of atoms. The atoms in all the boxes are identical. Which transition from one state to another best represents:



- a. melting
- b. freezing
- c. evaporating
- d. condensation
- e. sublimation

Skill 6.03: Describe the energy changes that accompany physical transformations**Skill 6.03 Concepts**

When physical transformations occur, energy is always transferred. The following demonstration is illustrative.

Data collection

Wet your right hand with hand sanitizer – wait 10 seconds and note how it feels

Wet your right hand with water – wait 10 seconds and note how it feels

Skill 6.03 Example 1

- a. After 10 seconds, did one hand feel cooler than the other? Which hand felt cooler, the right or left?
- b. What happened to the liquids on your hands?
- c. Did energy enter or leave the liquid during this process? How do you know?
- d. Did energy enter or leave your skin during this process? How do you know?

Skill 6.03 Exercise 1

Skill 6.04: Define endothermic and exothermic**Skill 6.04 Concepts**

The terms endothermic and exothermic are often used to describe energy changes. When energy is absorbed, that is the transformation requires energy, the process is said to be endothermic. When energy is released, the process is exothermic.

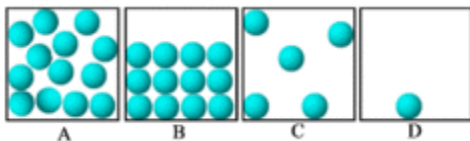
| | | |
|-------------|--------------------|--|
| Endothermic | Energy is absorbed | The change in energy is assigned a positive value, $+\Delta E$ |
| Exothermic | Energy is released | The change in energy is assigned a negative value, $-\Delta E$ |

Skill 6.04 Example 1

Was the process of the liquids leaving your skin an endothermic or an exothermic process?

Skill 6.04 Example 2

Each box shown contains a single atom or a sample of atoms. The atoms in all the boxes are identical. Which transition from one state to another:



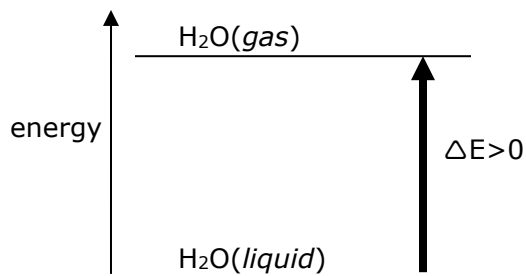
- Is most endothermic?
- Is most exothermic?

Skill 6.04 Exercise 1

Skill 6.05: Use energy diagrams to represent physical transformations

Skill 6.05 Concepts

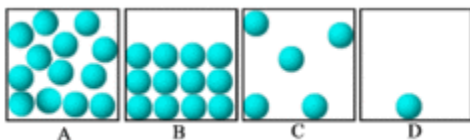
Energy diagrams are a graphical way to visualize changes in energy.



The energy diagram shows the differences in energy, ΔE , before and after the change. Notice that because $\Delta E > 0$, the final energy value is greater than the initial energy value. Therefore energy was required to bring about the indicated change.

Skill 6.05 Example 1

Each circle in the figure represents a molecule of water.



- If a container of water was cooled from 50°C to -20°C , which transition would be most favorable? Draw an energy diagram to represent this transition.
- If a container of water was heated from -20°C to 25°C , which transition would be most favorable? Draw an energy diagram to represent this transition.
- If a container of water was heated from -20°C to 120°C , which transition would be most favorable? Draw an energy diagram to represent this transition.

Skill 6.05 Exercise 1